Ordering number: EN3231C

Monolithic Linear IC

SANYO No. 3231C

LA1851N

DTS Single-chip Tuner IC

Overview

The LA1851N is a tuner IC designed for home-use stereo equipment which supports the SD system and IF counter system and incorporates AM/FM IF/MPX functions on a single chip.

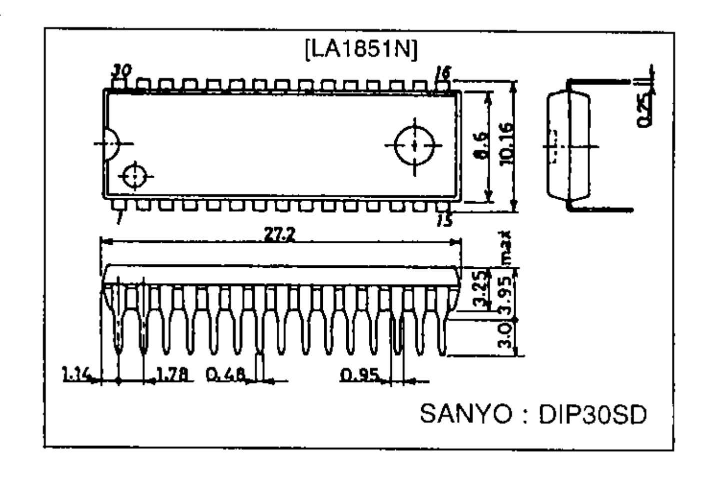
Features

- AM/FM tuner and multiplex demodulator on a single chip
- No multiplexer adjustments required
- Output (FM/AM) for IF counter buffer compatible with electronic tuning
- Stereo separation control
- Forced monaural and VCO stop functions
- Minimal multiplexer carrier leakage
- Excellent VCO temperature characteristics: f_o = 0.1% typ. with ±50 deg. variation

Package Dimensions

unit : mm

3196-DIP30SD



Functions

[FM Block]
- IF amplifier
- S-meter output
- Quadrature detector
- Tuner indicator (variable sensitivity)
- IF counter buffer

[AM Block]
- RF amplifier
- IF amplifier
- IF counter buffer
- Mixer
- Detector
- Tuner indicator (variable sensitivity)
- Oscillator
- AGC
- Oscillator buffer

[MPX Block]
- PLL decoder
- Separation control
- ST indicator
- No VCO adjustment
- VCO stop
- Forced monaural (VCO stop)
- Mute

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max	Pins 3, 7, 10, 21, 22 and 26	14	V
Maximum supply current	I_{CC} max	Pin 3	40	mA
		Pins 21 and 22	20	mA
Allowable power dissipation	Pd max	Ta = 70°C	480	mW
Operating temperature	Topr		–20 to +70	°C
Storage temperature	Tstg		–40 to +125	°C

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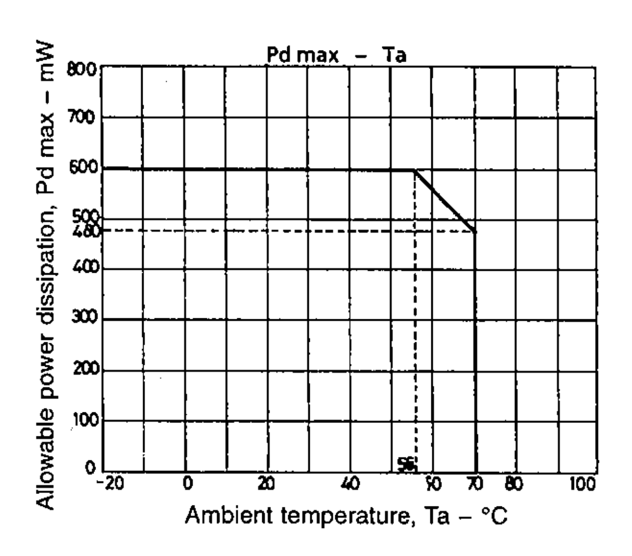
Operating Conditions at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		8.5	V
Operating supply voltage range	V_{CC} op		6 to 12	V

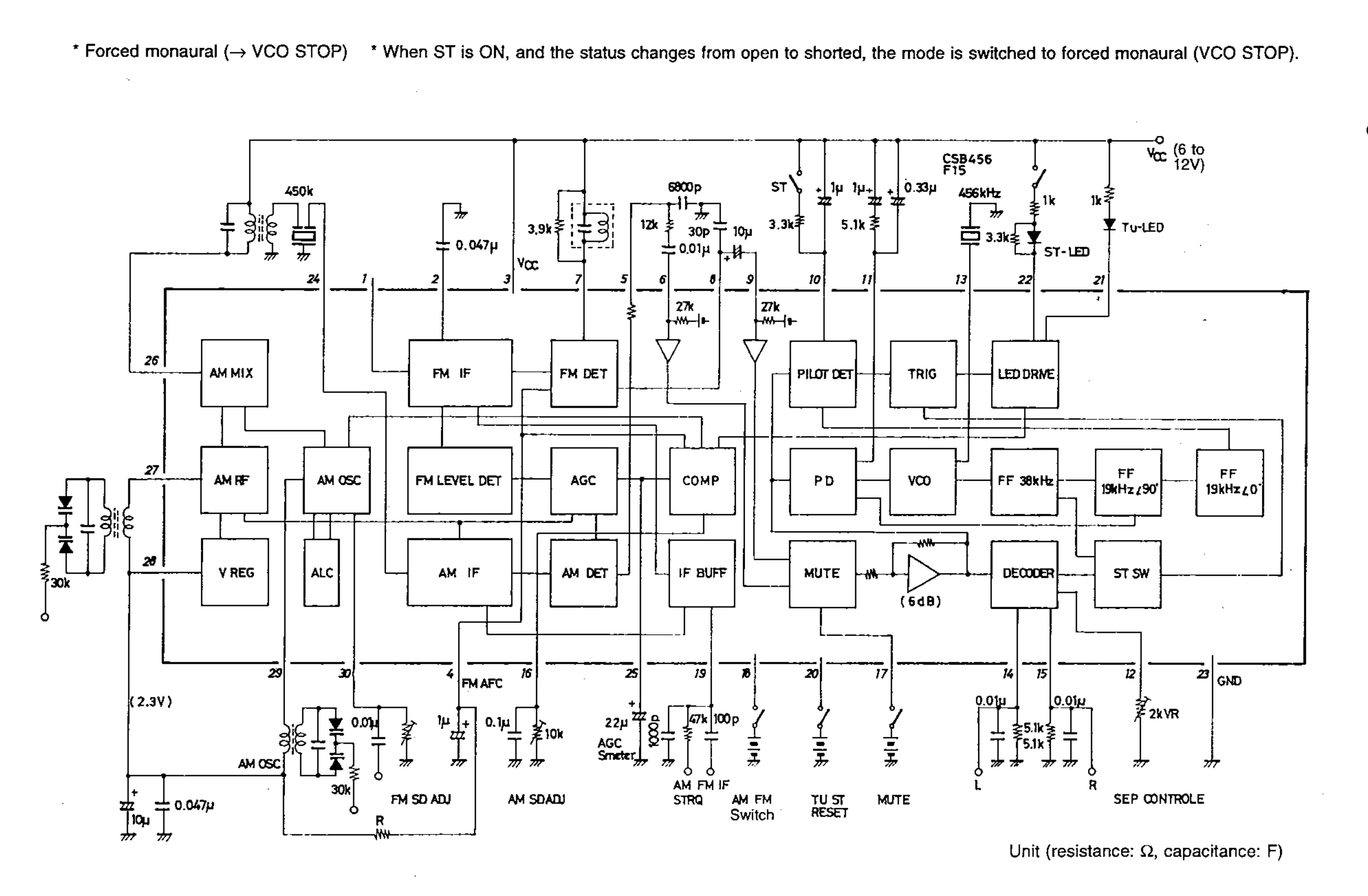
Operating Characteristics at Ta = 25°C, V_{CC} = 8.5 V

Parameter	Symbol	Conditions	min	typ	max	Unit
[AM: f_{in} = 1 MHz, 1 kHz tone]						
Quiescent current	I_{CCO}	No input		26	37	mA
Detector output	V_O1	V_{IN} = 23 dBμ, 30% AM	70	140	260	mV
	V_O2	V_{IN} =80 dBμ, 30% AM	170	280	390	mV
Singal-to-nose ratio	S/N1	V_{IN} = 23 dBμ, 30% AM	15	19		dB
	S/N2	V_{IN} = 80 dBμ, 30% AM	45	50		dB
Total harmonic distortion	THD1	V_{IN} = 80 dBμ, 30% AM		0.5	1.2	%
	THD2	V_{IN} = 100 dBμ, 30% AM		0.6	1.3	%
IF buffer output	V_{IF}	V_{IN} = 20 dBμ	110	170	230	mV
Local oscillator buffer output	V_{OSC}	f_{OSC} = 1.450 MHz	290	350	420	mV
Tuner turn-on sensitivity	V_S	Variable sensitivity		(13)		dBμ
[FM mono: f_{in} = 10.7 MHz, 1 kHz tone]						
Quiesect current	I_{CCO}	No input		27	38	mA
Input limiting sensitivity	LMS	3 dB down, 100% FM		32	38	dBμ
Demodulation output	V_O	V_{IN} = 100 dBμ, 100% FM	380	560	750	mV
Signal-to-noise ratio	S/N	V_{IN} = 100 dBμ	71	77		dB
Amplitude modulation rejection ratio	AMR	V_{IN} = 100 dBμ, 30% AM, 1 kHz tone	48	61		dB
Total harmonic distortion	THD	V_{IN} = 100 dBμ, 100% FM		0.2	1.0	%
Signal meter output	$V_{SM}1$	No input	0	0.1	0.3	%
	$V_{SM}2$	V_{IN} = 70 dBμ	0.7	1.2	1.8	V
	$V_{SM}3$	V_{IN} = 100 dBμ	2.1	2.9	3.3	V
IF buffer output	V_{IF}	V_{IN} = 50 dBμ	170	260	350	mV
Tuner turn-on sensitivity	V_S	Variable sensitivity		(59)		dBμ
[FM stereo: L + R = 90%, pilot = 10%, V_{IN} = 100 dBμ, f_m = 1 kHz]						
Channel separation	Sep 1K		30	45		dB
Total harmonic distortion	THD main	Stereo, main		0.3	1.0	%
Bandwidth	BW	Stereo, main	160	210	280	kHz
Channel balance	CB	Mono AM	–1.0	0	0.1	dB
Mute attenuation	ATT	Mono	67	82		dB
Lamp turn-on level	Pilot	Stereo, main	1.2	3.1	4.5	%
Lamp hysteresis	Hs	Stereo, main		(2.5)		dB

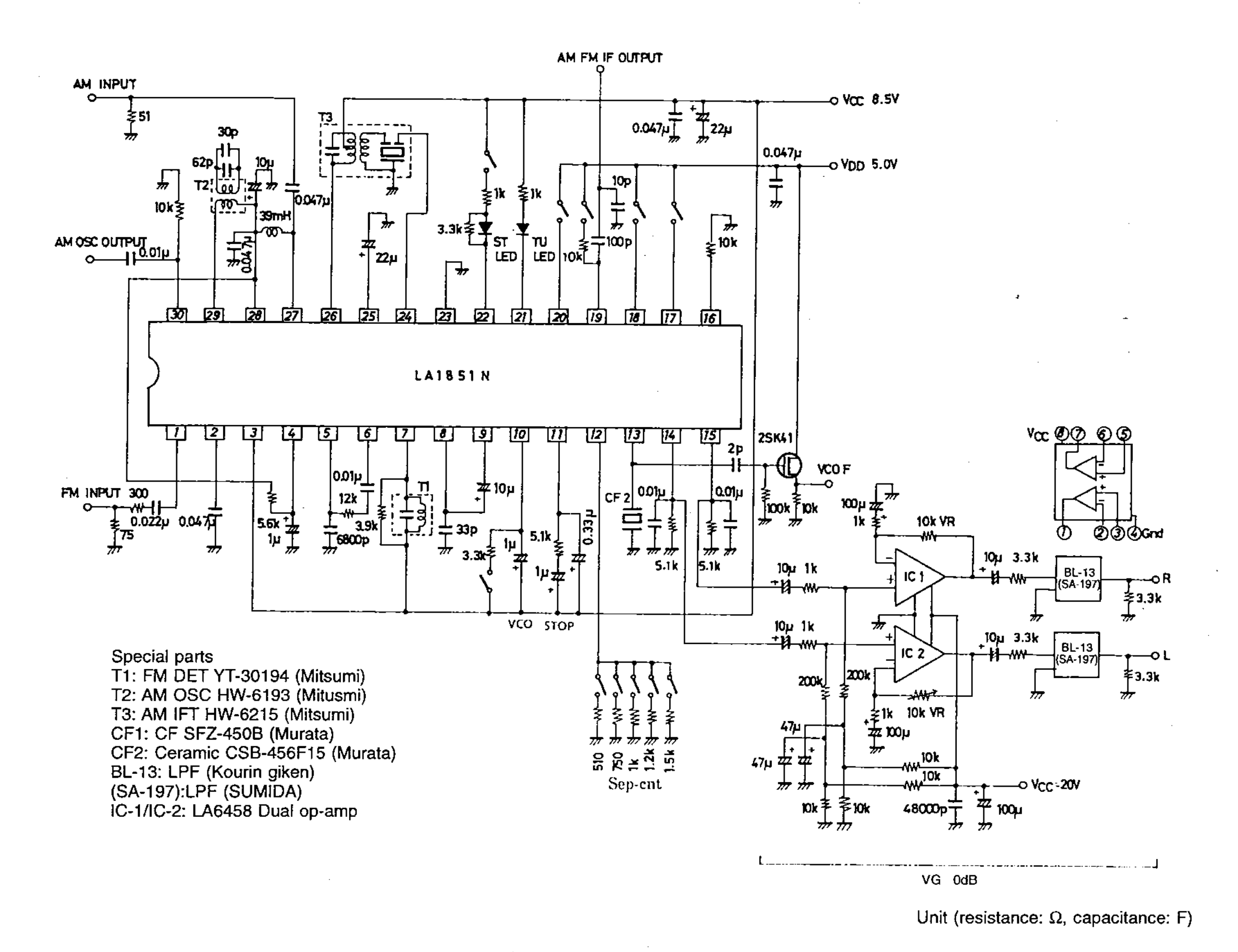
Note: Figures in parenthesis denote design guarantee values.



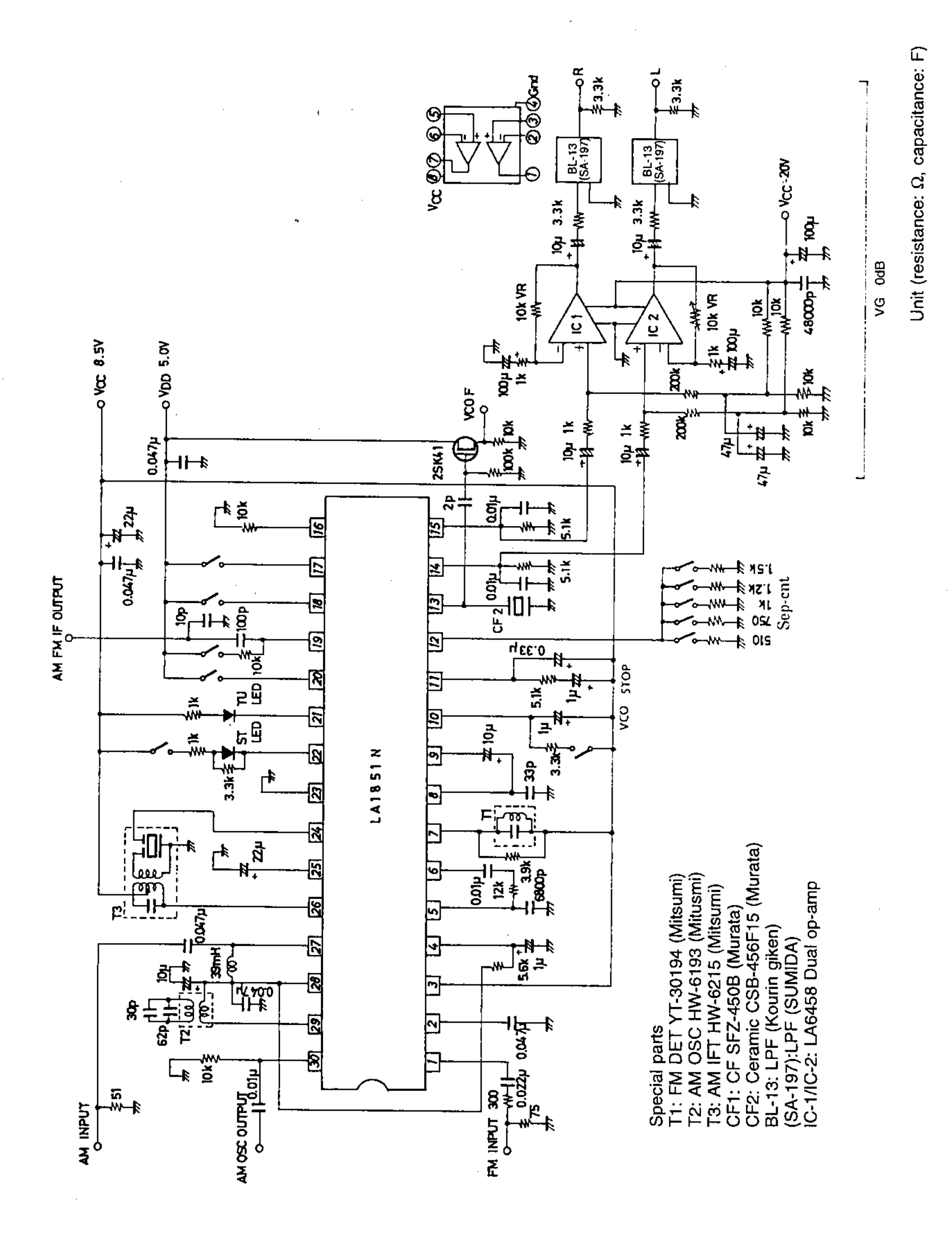
Block Diagram



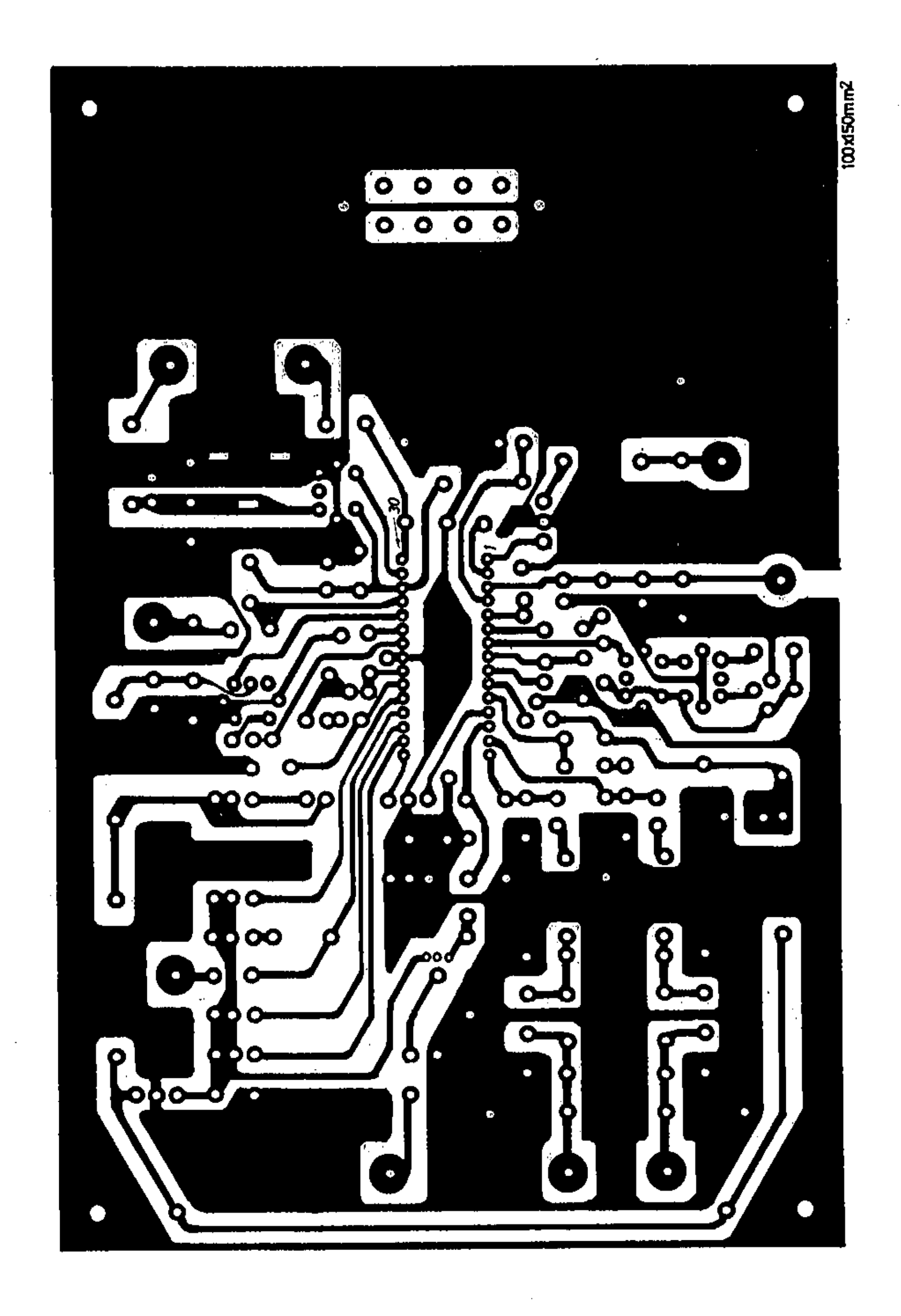
Test Circuit



Test Circuit



Printed Circuit Board Layout



Pin Functions

Pin no.	Function	Internal equivalent circuit	Remarks
1	FM IF input		Input impedance: 330 Ω
2	FM IF bias		
3	V_{CC}		
4	FM AFC output		Forced monaural mode is established in synchronization with the extinguishing of ST LED during FM AFC detuning.
5	AM demodulation output		
6	MPX AM DET input		MPX block AM demodulation input pin Input impedance: 27 kΩ
7	FM discriminator output		
8	FM demodulation output		Output impedance: 5 kΩ
9	MPX FM DET output		MPX block FM demodulation input pin Input impedance: 27 kΩ
10	MPX pilot sync detection filter		MPX VCO is stopped by shorting the V10 voltage in the V3 V_{CC} line. However, a 3.3 kΩ current-limiting resistor is required.
11	MPX PLL loop filter		

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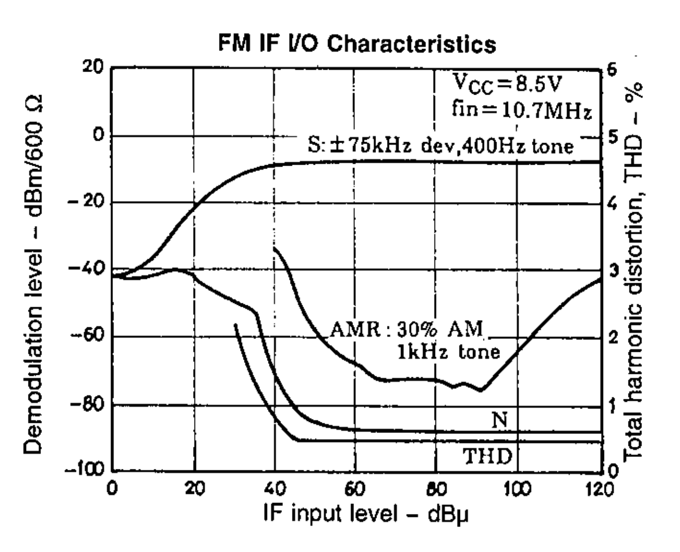
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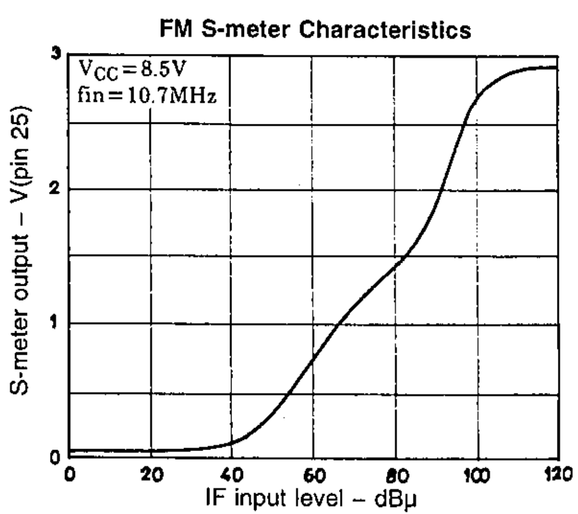
Pin no.	Function	Internal equivalent circuit	Remarks
12	MPX Separation control		
13	MPX VCO		Ceramic oscillator connection pin. CSB456F15 (Murata) recommended
14	MPX Left channel output		
15	MPX Right channel output		
16	AM SD ADJ		
17	MPX AF muting drive		V_{HI} (≧1.5 V): Mute on V_{LO} (<1.5 V): Mute off (μ-COM direct control enabled)
18	AM/FM switch		V_{HI} (≧ 1.5V): FM V_{LO} (< 1.5V): AM (μ-COM direct control enabled)
19	AM/FM IF counter output/ switch		V_{HI} (≧1.5 V): IF CNT ON V_{LO} (<1.5 V): IF CNT OFF (μ-COM direct control enabled)
20	Forced TU/ST LED extinguishing drive pin		V_{HI} (≧1.5 V): LED forced OFF (forced monaural mode) V_{LO} (<1.5 V): Normal (μ-COM direct control enabled)
21	AM/FM TU LED		
22	MPX ST LED		

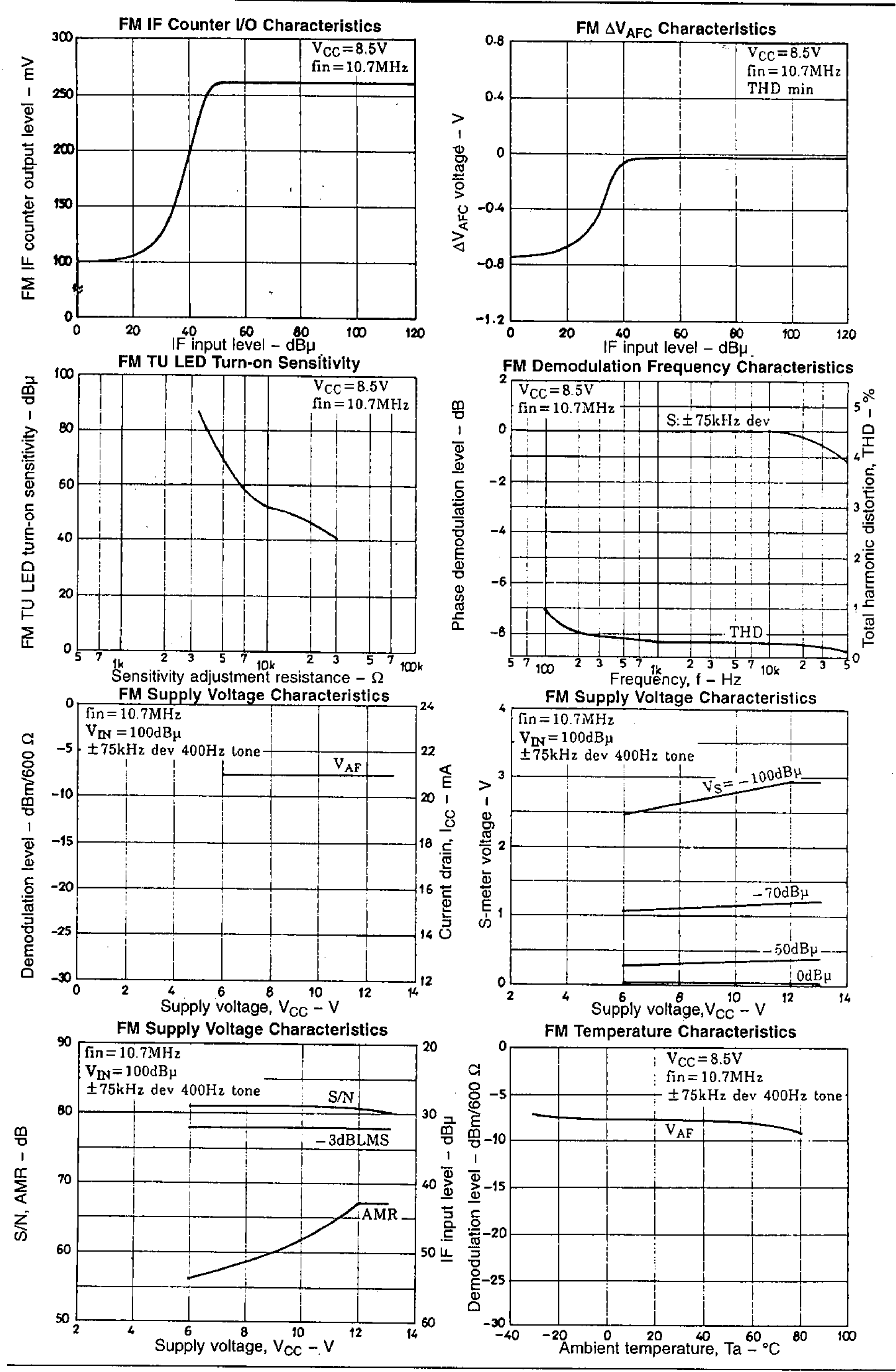
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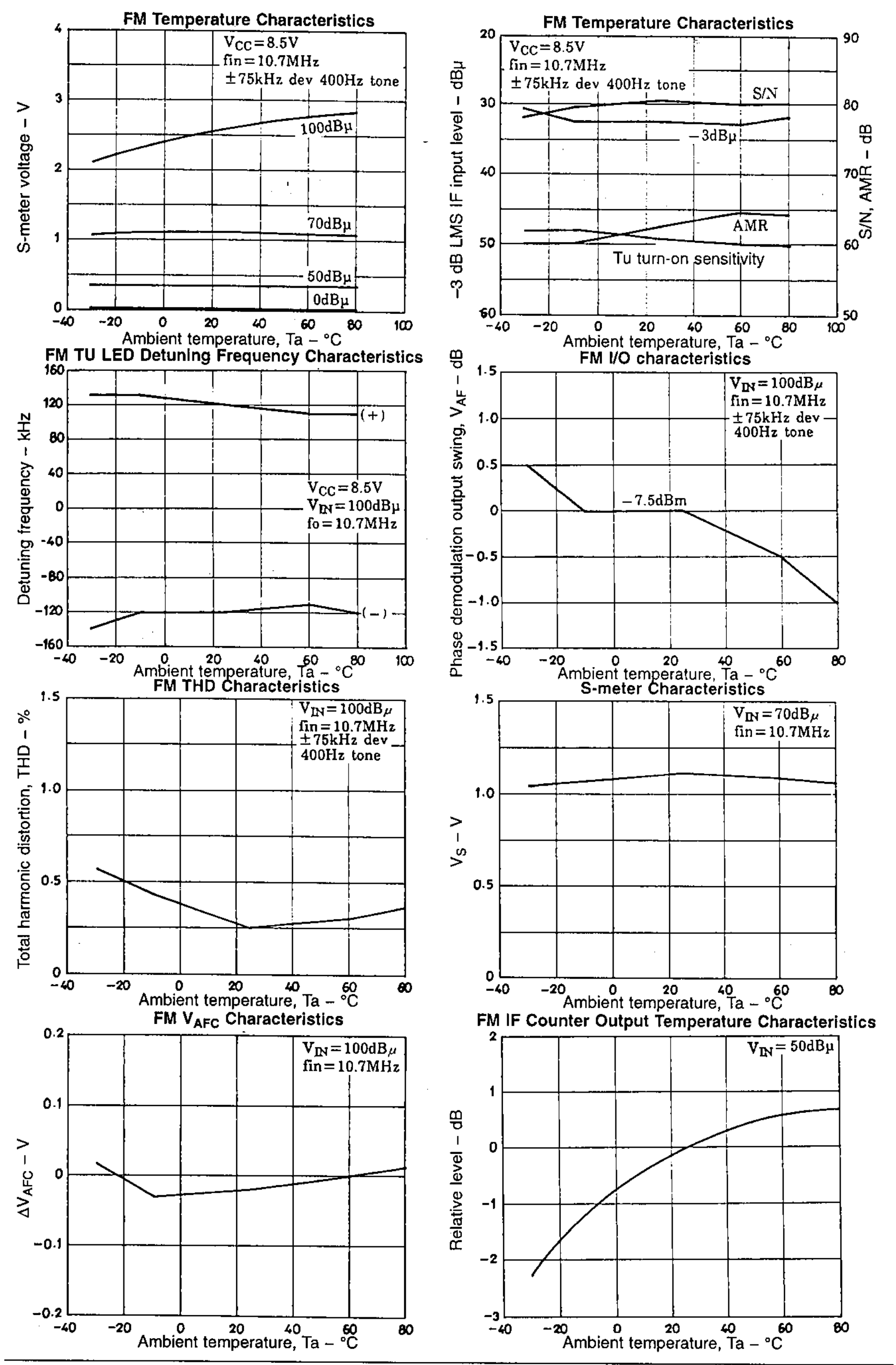
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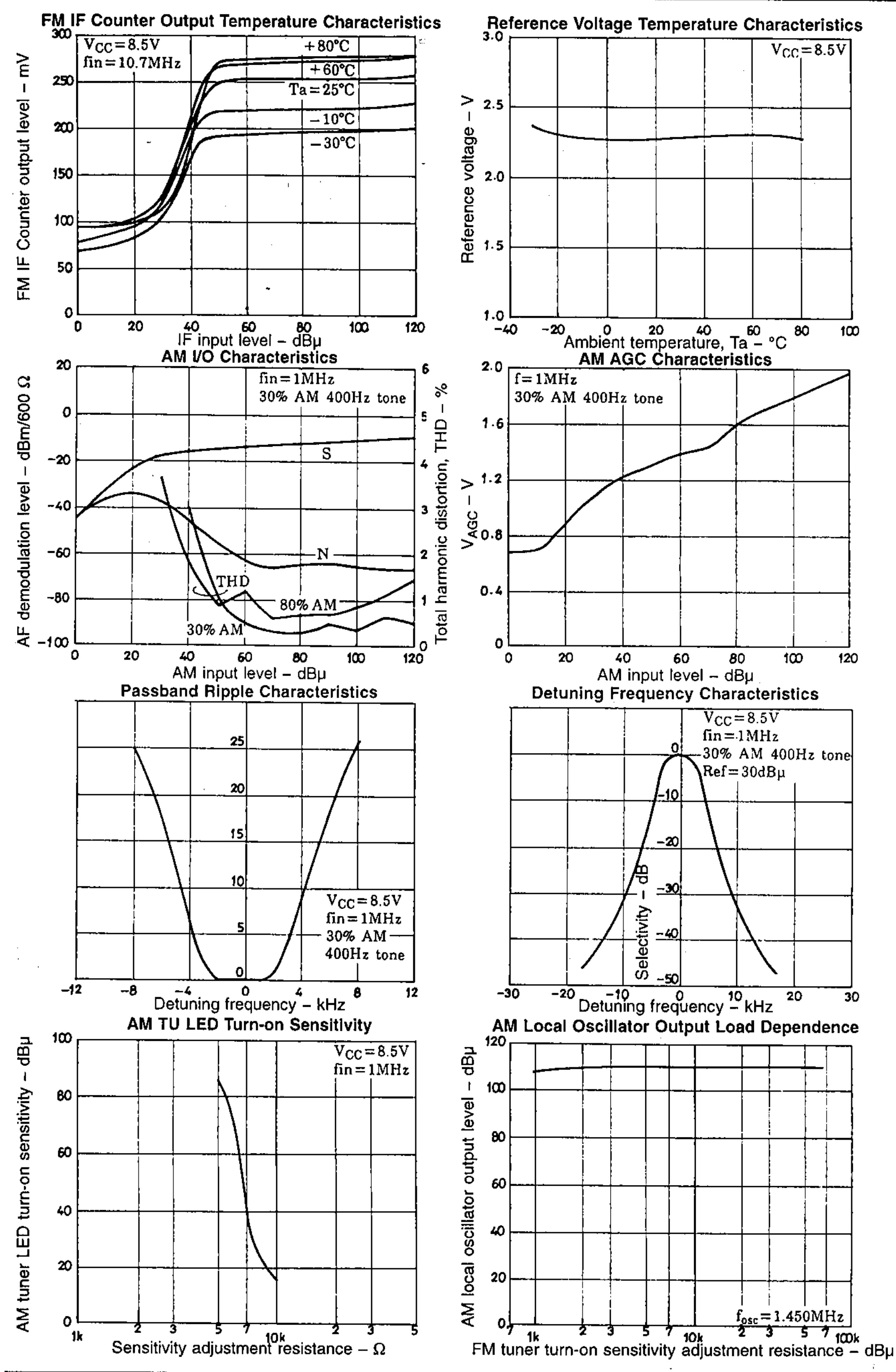
Number	Symbol	Equivalent circuit	Description
23	AM/FM MPX GND	GND (23)	
24	AM IF input	(24)	Input impedance: 2 kΩ
25	AM AGC output FM S-meter output	(25)	
26	AM MIXER output	(26)	
27	AM RF input	(27)	
28	V Reg	(28)	Vreg = 2.3 V
29	AM OSC	(29)	
30	AM OSC buffer output/ FM SD ADJ	(30)	

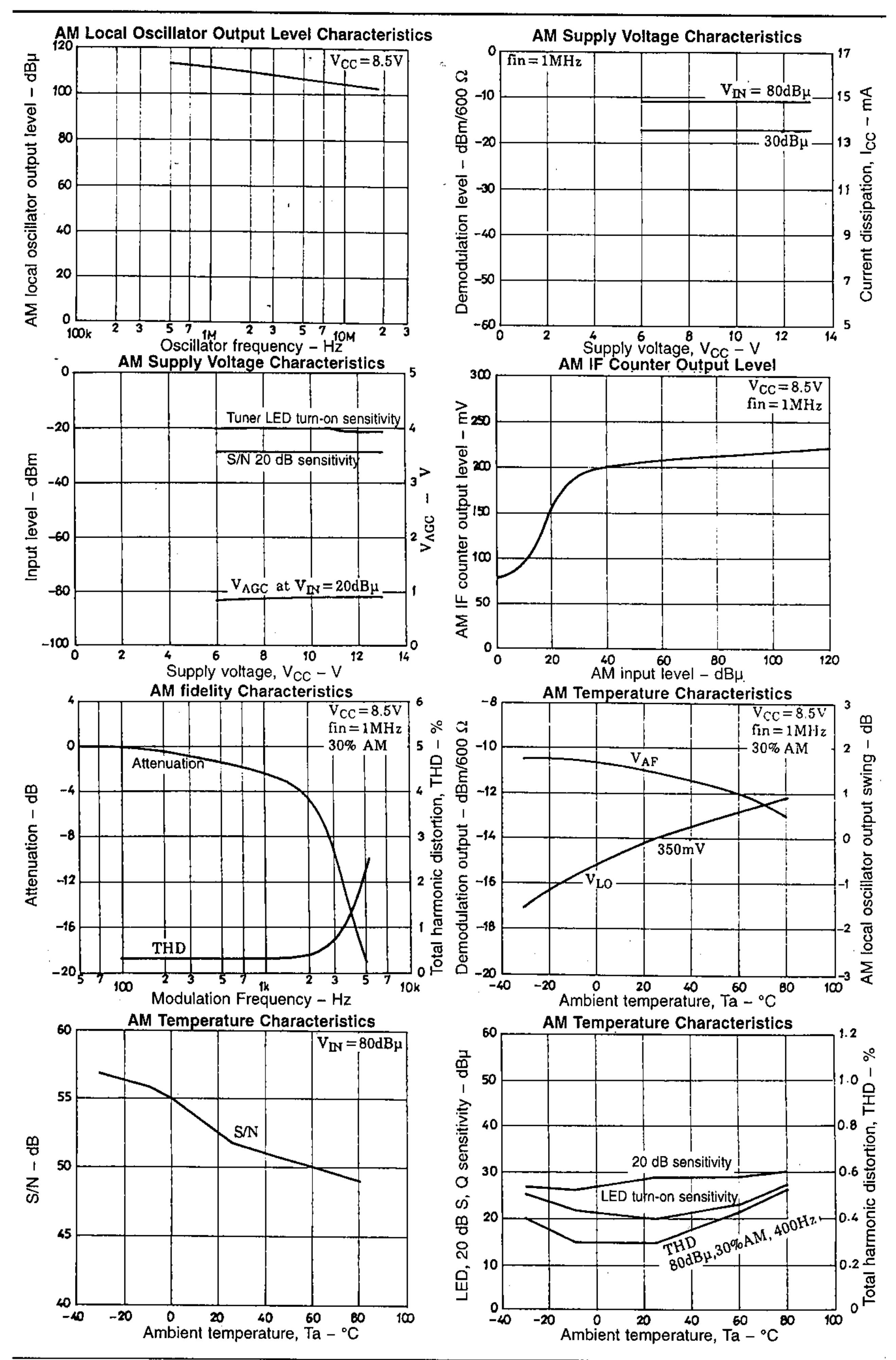


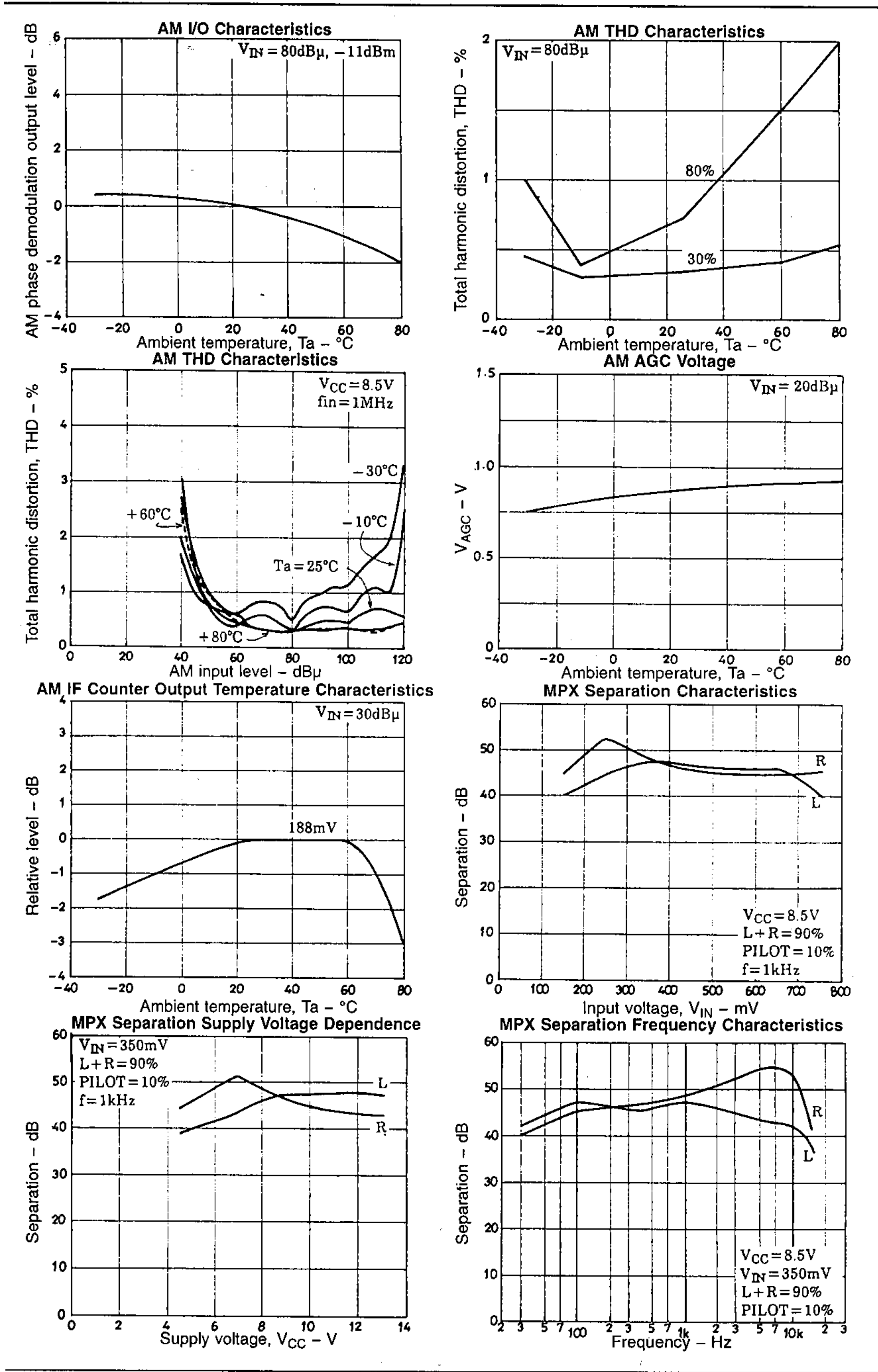


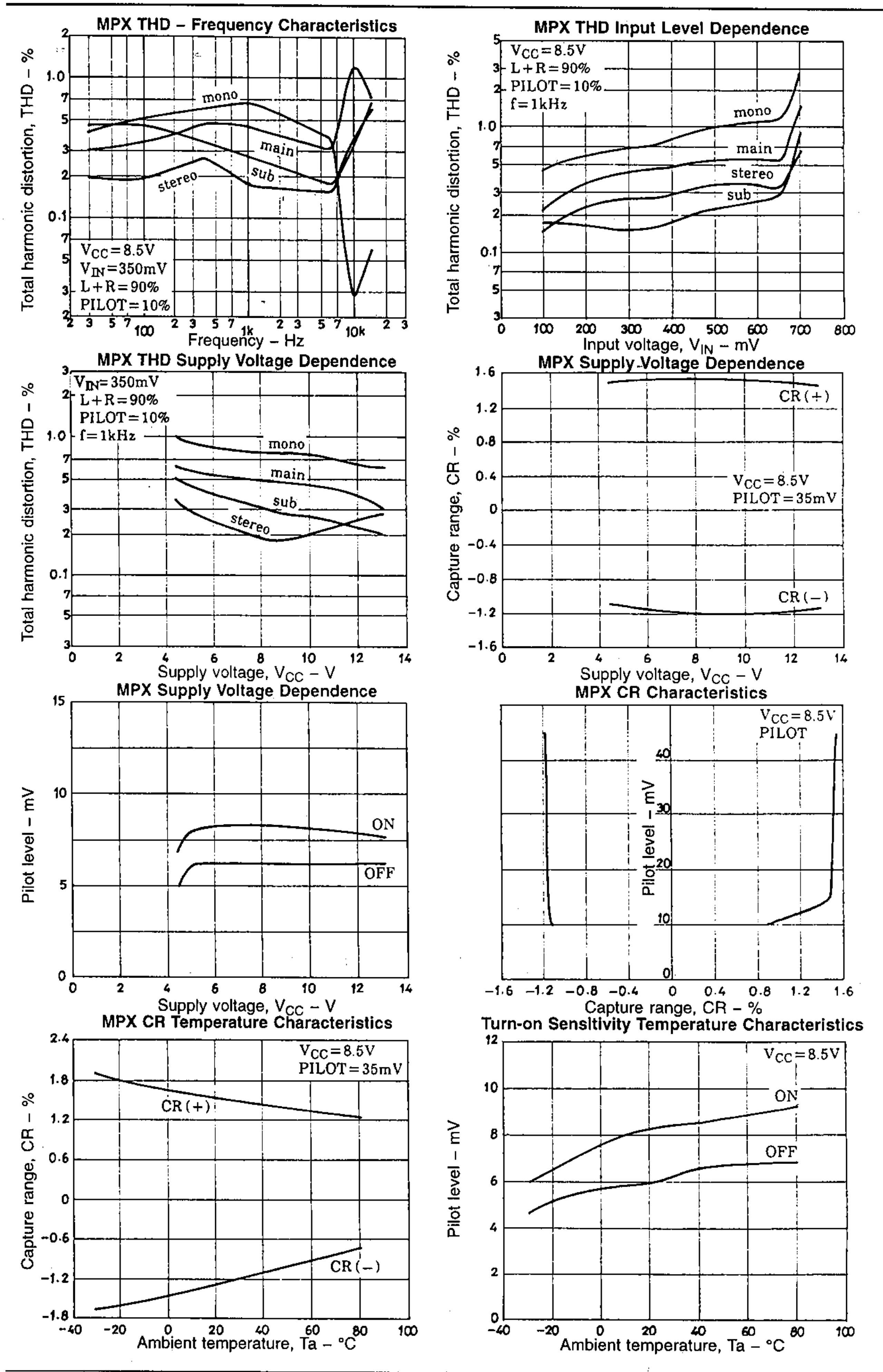

FM IF Counter I/O Characteristics
VCC=8.5V
fin=10.7MHz
FM IF counter output level – mV
IF input level – dBμ
FM ΔVAFC Characteristics
VCC=8.5V
fin=10.7MHz
THD min
ΔVAFC voltage – V
IF input level – dBμ
FM TU LED Turn-on Sensitivity
VCC=8.5V
fin=10.7MHz
FM TU LED turn-on sensitivity – dBμ
Sensitivity adjustment resistance – Ω
FM Demodulation Frequency Characteristics
VCC=8.5V
fin=10.7MHz
S: ±75kHz dev
THD
Phase demodulation level – dB
Total harmonic distortion, THD – %
Frequency, f – Hz
FM Supply Voltage Characteristics
fin=10.7MHz
VIN=100dBμ
±75kHz dev 400Hz tone
VAF
Demodulation level – dBm/600 Ω
Current drain, ICC – mA
Supply voltage, VCC – V
FM Supply Voltage Characteristics
fin=10.7MHz
VIN=100dBμ
±75kHz dev 400Hz tone
VS= –100dBμ
–70dBμ
–50dBμ
0dBμ
S-meter voltage – V
Supply voltage,VCC – V
FM Supply Voltage Characteristics
fin=10.7MHz
VIN=100dBμ
±75kHz dev 400Hz tone
S/N
–3dBLMS
AMR
S/N, AMR – dB
IF input level – dBμ
Supply voltage, VCC – V
FM Temperature Characteristics
VCC=8.5V
fin=10.7MHz
±75kHz dev 400Hz tone
VAF
Demodulation level – dBm/600 Ω
Ambient temperature, Ta – °C


FM Temperature Characteristics
VCC=8.5V
fin=10.7MHz
±75kHz dev 400Hz tone
100dBμ
70dBμ
50dBμ
0dBμ
S-meter voltage – V
Ambient temperature, Ta – °C
FM Temperature Characteristics
VCC=8.5V
fin=10.7MHz
±75kHz dev 400Hz tone
S/N
–3dBμ
AMR
Tu turn-on sensitivity
–3 dB LMS IF input level – dBμ
S/N, AMR – dB
Ambient temperature, Ta – °C
FM TU LED Detuning Frequency Characteristics
(+)
(–)
VCC=8.5V
VIN=100dBμ
fo=10.7MHz
Detuning frequency – kHz
Ambient temperature, Ta – °C
FM I/O characteristics
VIN=100dBμ
fin=10.7MHz
±75kHz dev
400Hz tone
–7.5dBm
Phase demodulation output swing, VAF – dB
Ambient temperature, Ta – °C
FM THD Characteristics
VIN=100dBμ
fin=10.7MHz
±75kHz dev
400Hz tone
Total harmonic distortion, THD – %
Ambient temperature, Ta – °C
S-meter Characteristics
VIN=70dBμ
fin=10.7MHz
VS – V
Ambient temperature, Ta – °C
FM VAFC Characteristics
VIN=100dBμ
fin=10.7MHz
ΔVAFC – V
Ambient temperature, Ta – °C
FM IF Counter Output Temperature Characteristics
VIN=50dBμ
Relative level – dB
Ambient temperature, Ta – °C


FM IF Counter Output Temperature Characteristics
VCC=8.5V
fin=10.7MHz
+80°C
+60°C
Ta=25°C
−10°C
−30°C
FM IF Counter output level – mV
IF input level – dBμ
Reference Voltage Temperature Characteristics
VCC=8.5V
Reference voltage – V
Ambient temperature, Ta – °C
AM I/O Characteristics
fin=1MHz
30% AM 400Hz tone
S
N
THD
80% AM
30% AM
AF demodulation level – dBm/600 Ω
Total harmonic distortion, THD – %
AM input level – dBμ
AM AGC Characteristics
f=1MHz
30% AM 400Hz tone
VAGC – V
AM input level – dBμ
Passband Ripple Characteristics
VCC=8.5V
fin=1MHz
30% AM
400Hz tone
Detuning frequency – kHz
Detuning Frequency Characteristics
VCC=8.5V
fin=1MHz
30% AM 400Hz tone
Ref=30dBμ
Selectivity – dB
Detuning frequency – kHz
AM TU LED Turn-on Sensitivity
VCC=8.5V
fin=1MHz
AM tuner LED turn-on sensitivity – dBμ
Sensitivity adjustment resistance – Ω
AM Local Oscillator Output Load Dependence
fosc=1.450MHz
AM local oscillator output level – dBμ
FM tuner turn-on sensitivity adjustment resistance – dBμ


AM Local Oscillator Output Level Characteristics
AM local oscillator output level – dBμ
VCC=8.5V
Oscillator frequency – Hz
AM Supply Voltage Characteristics
fin=1MHz
VIN= 80dBμ
30dBμ
Demodulation level – dBm/600 Ω
Current dissipation, ICC – mA
Supply voltage, VCC – V
AM Supply Voltage Characteristics
Tuner LED turn-on sensitivity
S/N 20 dB sensitivity
VAGC at VIN=20dBμ
Input level – dBm
VAGC – V
Supply voltage, VCC – V
AM IF Counter Output Level
VCC=8.5V
fin=1MHz
AM IF counter output level – mV
AM input level – dBμ
AM fidelity Characteristics
VCC=8.5V
fin=1MHz
30% AM
Attenuation
THD
Attenuation – dB
Total harmonic distortion, THD – %
Modulation Frequency – Hz
AM Temperature Characteristics
VCC=8.5V
fin=1MHz
30% AM
VAF
350mV
VLO
Demodulation output – dBm/600 Ω
AM local oscillator output swing – dB
Ambient temperature, Ta – °C
AM Temperature Characteristics
VIN=80dBμ
S/N
S/N – dB
Ambient temperature, Ta – °C
AM Temperature Characteristics
20 dB sensitivity
LED turn-on sensitivity
THD
80dBμ,30%AM, 400Hz
LED, 20 dB S, Q sensitivity – dBμ
Total harmonic distortion, THD – %
Ambient temperature, Ta – °C


AM I/O Characteristics
V_{IN}=80dBμ, −11dBm
AM phase demodulation output level – dB
Ambient temperature, Ta – °C
AM THD Characteristics
V_{IN}=80dBμ
80%
30%
Total harmonic distortion, THD – %
Ambient temperature, Ta – °C
AM THD Characteristics
V_{CC}=8.5V
fin=1MHz
−30°C
+60°C
−10°C
Ta=25°C
+80°C
Total harmonic distortion, THD – %
AM input level – dBμ
AM AGC Voltage
V_{IN}= 20dBμ
V_{AGC} – V
Ambient temperature, Ta – °C
AM IF Counter Output Temperature Characteristics
V_{IN}=30dBμ
188mV
Relative level – dB
Ambient temperature, Ta – °C
MPX Separation Characteristics
R
L
V_{CC}=8.5V
L+R=90%
PILOT=10%
f=1kHz
Separation – dB
Input voltage, V_{IN} – mV
MPX Separation Supply Voltage Dependence
V_{IN}=350mV
L+R=90%
PILOT=10%
f=1kHz
L
R
Separation – dB
Supply voltage, V_{CC} – V
MPX Separation Frequency Characteristics
R
L
V_{CC}=8.5V
V_{IN}=350mV
L+R=90%
PILOT=10%
Separation – dB
Frequency – Hz


MPX THD – Frequency Characteristics
Total harmonic distortion, THD – %
Frequency – Hz
mono
main
sub
stereo
VCC=8.5V
VIN=350mV
L+R=90%
PILOT=10%
MPX THD Input Level Dependence
VCC=8.5V
L+R=90%
PILOT=10%
f=1kHz
Input voltage, VIN – mV
MPX THD Supply Voltage Dependence
VIN=350mV
Supply voltage, VCC – V
MPX Supply Voltage Dependence
Capture range, CR – %
CR(+)
CR(–)
PILOT=35mV
Pilot level – mV
ON
OFF
MPX CR Characteristics
PILOT
Capture range, CR – %
MPX CR Temperature Characteristics
Ambient temperature, Ta – °C
Turn-on Sensitivity Temperature Characteristics